an inner pump electrode exposed to the gas mixture via the diffusion barrier, an outer pump electrode exposed to the gas mixture, and a solid electrolyte body arranged between the inner pump electrode and the outer pump electrode;

a joint supply conductor section through which the Nernst electrode and the inner pump electrode are connected to a circuit arrangement for controlling and evaluating the probe; and

a loaded voltage divider including a plurality of resistors that are arranged such that a negative feedback of a Nernst voltage circuit and of a pump voltage circuit is optimized, the plurality of resistors including a joint supply conductor resistor associated with the Nernst electrode and the inner pump electrode; wherein the negative feedback is optimized by adjusting magnitudes of the resistors.

REMARKS

I. THE REJECTION OF CLAIMS 6-12 UNDER 35 U.S.C. § 112, FIRST PARAGRAPH, FOR LACK OF ENABLEMENT

Claims 6-12 were rejected under 35 U.S.C. § 112, first paragraph, for lack of enablement.

In the Office Action, the Examiner argues that independent claim 6 is not enabled with respect to the terms "loaded voltage divider" and "negative feedback." Particularly with respect to the latter term, the Examiner argues that because the contact point 52 leading from the inner pumping electrode and the Nernst electrode is connected to ground, that it is therefore unclear how increasing the resistance of R3 results in negative feedback. It is respectfully submitted that the specification provides sufficient guidance to those of skill in the art with respect to this issue, as the following discussion indicates.

An objective of the present invention is to reduce the so-called lambda = 1 ripple that may occur in the event of a "jump response" in response to a transition from the

[handwritten margin notes: "D1 Cont'd", "I never said this. I speculate that it would be grounded"]

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"rich" range to the "lean" range. (See Specification, page 2, lines 28-30). The present invention attains this objective by providing a joint supply conductor resistor of the Nernst electrode and of the inner pump electrode formed by a loaded voltage divider whose individual resistors are arranged so that negative feedback of a Nernst voltage circuit and of a pump voltage circuit is increased. (See Specification, page 3, lines 4-7).

Figure 2 and the text on page 6 of the specification explain the operation of the "negative feedback" and the "loaded voltage divider." Viewing point 34 of Figure 2 as ground, the voltage at the Nernst reference electrode can be expressed as:

$$V_{Nernst} = I_{const} \cdot R2 + R3 \cdot (I_p + I_{const})$$

where the first term represents the voltage drop across the resistor R2 through which a constant current flows (because it is coupled to a current source; see specification page 2, line 8), and the second term represents the voltage drop across R3 through which both the constant current and the pump current flow. Thus, resistor R3 creates a voltage divider with respect to the contact point 52 since it (R3) divides the voltage drop to ground with resistors R1 and R2 respectively.

Expanding the equation above, one of the terms of V_{Nernst} is $R3 * I_{const}$, so that the magnitude of the voltage at the Nernst electrode depends directly on the magnitude of the resistance at R3, i.e., increasing the resistance R3 increases the voltage level at the Nernst electrode. Therefore, by increasing the resistance R3, negative feedback is increased at the minus terminal of the amplifier, reducing its output, which in turn prevents overswings of the pumping voltage of the pump cell. In addition, the voltage divider arrangement aids in decoupling the magnitude of the Nernst voltage from the pump current I_p. This also reduces the ripple effect found to impair the performance of the lambda sensor.

However, since there is a complex relationship between R1, R2, R3, I_p and the voltage levels at the Nernst

[handwritten margin note, right: Is this confirmation of my paragraph2?]

[handwritten margin note, left: Unclear, these elements are not connected to each other]

[handwritten margin note, right: from where to where? how is the terminal experiencing neg. feedback?]

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electrode, the inner pump electrode and the outer pump
electrode, the resistance values of R1, R2, and R3 are
optimized to reduce the rippling effect, to maintain a
sufficient pump current, and to produce a correct calibration
between an anodic and cathodic current at the stoichiometric
point. (See Specification, page 3, lines 8-11).

[handwritten margin note: this is all relative language all unclear]

It is believed the discussion above addresses the
Examiner's concerns with respect to the terms "loaded voltage
divider," "negative feedback," and "optimize" with respect to
claim 6.

The Examiner has also expressed the concern that one
of ordinary skill in the art would not be enabled to optimize
the values of the resistors to arrive at a minimum current
above a minimum pump current when the current is a function of
oxygen concentration. Applicants address this concern by
noting that in lambda sensors, the pump current depends on the
oxygen concentration as detected by the measuring cell. (See
Specification, page 1, lines 20-23). Thus, it is conventional
to provide feedback from the measuring cell to control the pump
current. As also noted in the Background section of the
specification, the transfer relation between the detected
oxygen concentration and the pumping current can be distorted
at the stoichiometric point due to coupling effects.
Therefore, according to the teachings of the present invention,
one of ordinary skill in the art could, without undue
experimentation, choose resistances R1, R2, R3 (and R4) by a
process of monitoring and adjustments to arrive at a
combination where a desired potential difference is maintained
between the Nernst electrode and the reference electrode, while
simultaneously, the ripple effect at the stoichiometric point
is reduced to a point where precise transitions between "rich"
and "lean" states (or vice versa) are achieved.

[handwritten margin note: the net result is still $I_p \propto O_{2(g)}$]

[handwritten margin note: this doesn't answer the question]

For at least the above reasons, it is respectfully
submitted that claims 6-12 are enabled under § 112, first
paragraph.

II. THE REJECTION OF CLAIMS 6-12 UNDER 35 U.S.C. § 112, FIRST PARAGRAPH, FOR LACK OF WRITTEN DESCRIPTION

Claims 6-12 were rejected under 35 U.S.C. § 112, first paragraph, for lack of written description.

The Examiner has objected to the term "adversely affected" in claim 6 on the grounds that there does not appear to be support for this term in the original disclosure.

w/d the new matter rej.

Without agreeing with the merits of this rejection, claim 6 has been amended to remove this term. Therefore, it is respectfully submitted that the rejection has been rendered moot.

III. THE REJECTION OF CLAIMS 6-12 UNDER 35 U.S.C. § 112, SECOND PARAGRAPH

Claims 6-12 were rejected under 35 U.S.C. § 112, second paragraph, as indefinite.

The terms "optimized" and "maximized" of claims 6 and 7 have been objected to as indefinite. In addition, the term "operation of the pump cell" has been objected to as unclear. The last term, "operation of the pump cell," has been removed from claim 6, thereby rendering the rejection moot.

As discussed above with respect to the enablement rejection, in the first instance, the specification clearly indicates that the terms optimize and maximize (referring to the negative feedback) refer to optimizing or maximizing the effectiveness of the voltage divider arrangement in reducing the effects of the ripple at lambda=1, which is an objective of the present invention.

The Examiner appears to be stating that since claim 7 refers to maximizing negative feedback, that claims 6 and 7 are indefinite because there are no countervailing considerations to limit the magnitude of the feedback. However, it is well within the ordinary skill in the art to optimize a parameter within a limit that preserves the functionality of the lambda sensor as a whole. Thus, given the variances between devices, one skilled in the art would understand from the terms of

claims 6 and 7, that through a suitable combination of resistances, the ripple effect can be ameliorated without sacrificing the normal operation of the measurement and pumping cells of the device.

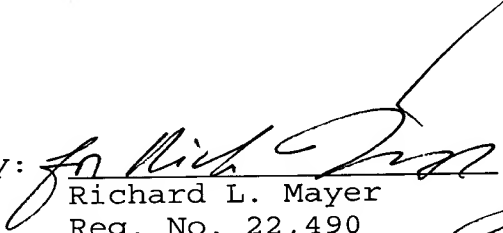It is therefore respectfully submitted that claims 6-12 are definite.

IV. CONCLUSION

In light of the foregoing, Applicants respectfully submit that pending claims 6-12 are in condition for allowance. Prompt reconsideration and allowance of the present application are therefore earnestly solicited.

Respectfully submitted,

KENYON & KENYON

Dated: June 30, 2003

By: _____
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PATENT & TRADEMARK OFFICE

6

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claim 6 has been amended without prejudice as follows:

6.   (Three times Amended) A probe for determining an oxygen concentration in a gas mixture, comprising:

a Nernst measuring cell including:

a Nernst electrode exposed to the gas mixture to be measured via a diffusion barrier, a reference electrode exposed to a reference gas, and a solid electrolyte body arranged between the Nernst electrode and the reference electrode;

a pump cell including:

an inner pump electrode exposed to the gas mixture via the diffusion barrier, an outer pump electrode exposed to the gas mixture, and a solid electrolyte body arranged between the inner pump electrode and the outer pump electrode;

a joint supply conductor section through which the Nernst electrode and the inner pump electrode are connected to a circuit arrangement for controlling and evaluating the probe; and

a loaded voltage divider including a plurality of resistors that are arranged such that a negative feedback of a Nernst voltage circuit and of a pump voltage circuit is optimized, the plurality of resistors including a joint supply conductor resistor associated with the Nernst electrode and the inner pump electrode;

wherein the negative feedback is optimized <u>by adjusting magnitudes of the resistors</u> [such that operation of the pump cell is not adversely affected].